A Survey for Alkaloids in Hawaiian Plants. II

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WITH PART I[3] of this series a systematic survey for alkaloids in Hawaiian plants was initiated. This paper reports tests on 29 additional species as well as tests on different plant parts from 18 of the species covered by Part I.

All of the specimens tested were collected from living plants on the island of Oahu except for one, *Curcuma xanthorrhiza.*

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METHODS

The testing methods devised for this survey have already been described (Swanholm *et al.*, 1959). The only modification in the testing procedure involves the extraction technique.

EXTRACTION OF PLANT MATERIAL. About 2–5 grams of the plant material was pulped in a Waring blender with 100 ml. water for 5–10 minutes. The plant slurry was transferred to an Erlenmeyer flask and 5 ml. of concentrated hydrochloric acid were added. The slurry was digested on a hot plate at about 80° C. for 6–12 hours. The cooled slurry was filtered through fine paper and 0.2 ml. of the filtrate was used in each test.

The information obtained by digesting with Prollius' fluid appeared insufficient to warrant its continued use.

KEY TO ABBREVIATIONS IN TABLE 1

The results of the spot tests are given in the following order and abbreviated form:

BINOMIAL	The accepted botanical name. The authority is omitted to conserve space. An asterisk (*) indicates introduced species.
LOCAL NAME	The Hawaiian or vernacular name, if known.
LOCALITY	The nearest town or other prominent map feature.
DATE COLLECTED	Date of actual collection in the field.
DATE TESTED	Date of actual application of spot tests.
PLANT PART(S)	B—bark, Br—branchlet, F—fruit, Fl—flower, H—herb or whole plant, L—leaf, R—root or underground part, RB—root bark, S—seed, St—stem, W—wood, I—immature, M—mature.
ALKALOID REAGENTS	M—Mayer's, P—Picric Acid (Hager's), I—Iodine (Wagner's), D—Dragendorff's, S—Sonnenschein's, T—Silicotungstic Acid.
PRECIPITATES	The precipitates from the hydrochloric acid extract are classified on a tr (trace), + (light), ++ (heavy) basis. A — indicates no precipitation and a ? indicates that the test was meaningless.

TABLE 1

RESULTS OF SPOT TESTS FOR ALKALOIDS
(Plants are listed alphabetically within each taxon.)

BINOMIAL	LOCAL NAME	LOCALITY	DATE COLLECTED	DATE TESTED	PLANT PART(S)	ALKALOID PRECIPITATES	COMMENTS
APOCYNACEAE							
Pteralyxia macrocarpa	Kaulu	Pupukea–Kahuku Road, Oahu	27 Jan 58	19 Feb 58	B	S+,D+,I+ M—,T+,P?	Endemic genus of two species
					RB	S+,D+,I+ Mtr,T+,P+	
					Trunk Heartwood	S+,D+,Itr M—,Ttr,P—	
					Root Heartwood	S—,D—,I— M—,T—,P—	
					L	S++,D++,I++ M+,T++,P+	
ARACEAE							
*Colocasia esculenta**	Taro, Kalo	Waiahole ditch trail, Oahu	27 Jan 58	19 Feb 58	H	S+,Dtr,I— M—,T++,P—	Aboriginal introduction, cultivated specimen
BORAGINACEAE							
*Cordia subcordata**	Kou	UH campus, Oahu	23 Jan 58	24 Jan 58	B,Fl, L,St	S+,D—,I— M—,T+,P—	Aboriginal introduction, cultivated specimen
CELASTRACEAE							
Perrottetia sandwicensis	Olomea	Pupukea trail, Oahu	15 Jun 58	18 Jun 58	Br,R	S+,D—,I— M—,T+,Ptr	Endemic species
COMPOSITAE							
Hesperomannia Swezeyi	—	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	L,R,St	S++,D+,I— Mtr,T++,P—	Endemic genus
CYATHEAE							
Cibotium Chamissoi	Hapu'u-'i'i	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	Fronds,St, Tubercles	S+,Dtr,Itr M—,T+,P—	Endemic tree fern
C. splendens	Hapu'u	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	Fronds,St, Tubercles	S++,Dtr,I— M—,T++,P—	Endemic tree fern
EUPHORBIACEAE							
Euphorbia Rockii	'akoko	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	Fl,L,R,St	S+,D—,I— M—,T+,P—	Endemic species

TABLE 1 *Continued*

BINOMIAL	LOCAL NAME	LOCALITY	DATE COLLECTED	DATE TESTED	PLANT PART(S)	ALKALOID PRECIPITATES	COMMENTS
GESNERIACEAE							
Cyrtandra brevicalyx	Pioha	Pupukea trail, Oahu	15 Jun 58	18 Jun 58	B,Br,R	S+,D+,Itr Mtr,T+,P—	A genus of 130 Hawaiian species
C. leucocalyx	Kanawaoke'oke'o	Pupukea trail, Oahu	15 Jun 58	18 Jun 58	L,R,St	S+,D+,I— Mtr,T+,Ptr	Endemic species
GOODENIACEAE							
Scaevola mollis	Naupaka-kuahiwi	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	B,Fl,L,R,St	S++,D+,I+ M+,T++,Ptr	Endemic species
LEGUMINOSAE							
*Caesalpinia pulcherrima**	Pride of Barbados, 'ohai-ali'i	UH campus, Oahu	23 Jun 58	24 Jun 58	B,F,Fl,L,St	S++,Dtr,I— M—,T++,P—	Cultivated specimen
LILIACEAE							
*Cordyline terminalis**	Ti, Ki	UH campus, Oahu	23 Jun 58	24 Jun 58	B,L,R,St	S—,Dtr,Itr M—,Ttr,P—	Aboriginal introduction, cultivated specimen
LOBELIACEAE							
Clermontia persicaefolia	'oha-wai	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	B,L,R	Str,D—,I— M—,Ttr,Ptr	Endemic genus
			18 Jun 58	21 Jun 58	B,L,R	S++,D+,I+ Mtr,T++,Ptr	Different specimen from above
Cyanea sp.	'oha, 'oha-wai	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	L,R,St	S+,D+,I+ M+,I+,P+	Endemic genus
MALVACEAE							
*Hibiscus tiliaceus**	Hau	UH campus, Oahu	23 Jun 58	24 Jun 58	B,L,R,St	S+,Dtr,I— M—,T+,P—	Aboriginal introduction from tropical Asia, cultivated specimen
MORACEAE							
*Artocarpus incisus**	Breadfruit, 'ulu	UH campus, Oahu	23 Jun 58	24 Jun 58	B,F,L,R,St	S++,D+,I+ M—,T+,P—	Aboriginal introduction from Guam, cultivated specimen
MYRSINACEAE							
Myrsine sandwicensis	Kolea-lau-li'i	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	L,St	Str,D—,I— M—,Ttr,P—	Endemic species

PALMAE							
Pritchardia Hillebrandi	Loulu-lelo	UH campus, Oahu	23 Jun 58	24 Jun 58	R,St	Str,D—,I— M—,Ttr,P—	Endemic to Molokai Island, cultivated specimen
POLYPODIACEAE							
Grammitis tenella	—	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	H	S—,D—,I— M—,Ttr,P—	Endemic species
RUBIACEAE							
Gardenia Mannii	Nanu, Na'u	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	Br,L,St	S+,D++,I+ M+,T++,P++	Endemic to Oahu
			15 Jun 58	17 Jun 58	R	S+,D+,Itr Mtr,T+,Ptr	
RUTACEAE							
Fagara semiarticulata	Kawa'u, Hea'e	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	Fl,L,R,St	S++,D++,I++ M++,T++,P++	Endemic species
				18 Jun 58	ML	S++,D++,I++ M++,T++,P++	
					Trunk Heartwood	S+,D+,I+ Mtr,T+,Ptr	
Pelea sandwicensis	Alani	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	L,R,St	S++,Dtr,Itr M—,T++,Ptr	Endemic species
					F,Fl	S++,Dtr,I— M—,T++,Ptr	
Platydesma campanulata	Pilo-kea	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	L,R,St	S++,D++,I++ M++,T++,P++	Endemic genus of 3 species
			18 Jun 58	21 Jun 58	B,L,R	S++,D++,I++ M++,T++,P++	
P. cornuta	Pilo-kea-lau-li'i	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	L,R,St	S++,D+,I+ Mtr,T++,P+	
SAPINDACEAE							
Sapindus oahuensis	'aulu, lonomea	Kealia trail, Oahu	18 Mar 58	20 Mar 58	MF,L,St	S++,D++,I— M—,T++,P—	Endemic to Oahu

TABLE 1 *Continued*

BINOMIAL	LOCAL NAME	LOCALITY	DATE COLLECTED	DATE TESTED	PLANT PART(S)	ALKALOID PRECIPITATES	COMMENTS
Sapindus oahuensis		UH campus, Oahu	20 Mar 58	21 Mar 58	B,R	Str,D—,I— M—,Ttr,P—	Cultivated specimen
SAPOTACEAE *Planchonella* sp.	'ala'a	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	B,Br	Str,Dtr,I— M—,T+,Ptr	Different from *P. sandwicensis*
SAXIFRAGACEAE *Broussaisia arguta*	Kanawao	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	Br,R	Str,D—,I— M—,T+,P—	Endemic genus of 2 species
ZINGIBERACEAE *Curcuma xanthorrhiza**	—	Indonesia	—	16 Mar 58	R	S—,D—,I— M—,T+,P—	Native to Indonesia

RESULTS AND DISCUSSION

Table 1 lists the results of the alkaloid tests which were carried out on 29 plant species, representing 26 genera and 23 families. The 5 species which gave positive tests (+ or ++) with all six reagents are listed in Table 2.

Table 3, which supplements Part I of this series, lists the results of the alkaloid tests which were carried out on 18 plant species, representing 16 genera and 13 families.

Results from Part I are included with the present results in the following analysis.

To date, 125 plant species, representing 94 genera and 57 families, have been tested for alkaloids. This constitutes approximately 10 per cent of the native Hawaiian flora.

It is worth noting that the endemic genus *Straussia* has given quite variable results even among specimens of the same species. This variability would suggest that a botanical revision of this genus is in order.

TABLE 2

SPECIES GIVING POSITIVE (+ OR ++) TESTS FOR ALKALOIDS

BINOMIAL	FAMILY	PLANT PART(S) TESTED
Cyanea sp.	Lobeliaceae	Leaves, Root, Stem
Fagara semiarticulata	Rutaceae	Leaves, Flowers, Root, Stem
Gardenia Mannii	Rubiaceae	Branchlet, Leaves, Stem
Platydesma campanulata	Rutaceae	Leaves, Root, Stem
Pteralyxia macrocarpa	Apocynaceae	Leaves

TABLE 3

SPECIES RE-EXAMINED FOR ALKALOIDS[1]

(Plants are listed alphabetically within each taxon.)

(For KEY TO ABBREVIATIONS, see Table 1)

BINOMIAL	LOCAL NAME	LOCALITY	DATE COLLECTED	DATE TESTED	PLANT PART(S)	ALKALOID PRECIPITATES	COMMENTS
APOCYNACEAE *Alyxia olivaeformis*	Maile	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	IF	Str,D—,I—,M—, T—,P—	Endemic species
ARALIACEAE *Tetraplasandra* sp.	Ohe	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	B	Str,Dtr,Itr,Mtr, Ttr,P?	Endemic genus
COMPOSITAE *Dubautia plantaginea*	Na'ena'e	Pupukea trail, Oahu	18 Jun 58	21 Jun 58	B,L,R	S++,D++,I+, M—,T++,Ptr	Endemic genus
EUPHORBIACEAE *Antidesma platyphyllum*	Ha'a, Hame	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	B,L,R	S+,D+,Itr,Mtr, T+,P—	Endemic species
LILIACEAE *Smilax sandwicensis*	Hoi-kuahiwi	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	R	Str,Dtr,I—,M—, T+,P—	Endemic species
LOBELIACEAE *Cyanea angustifolia*	'oha-wai, 'oha	Pupukea trail, Oahu	18 Jun 58	21 Jun 58	B,L,R	S++,D++,I++, M++,T++,P++	Endemic genus
MYRSINACEAE *Myrsine Lessertiana*	Kolea-lau-nui	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	B,Fl,R	S—,D—,I—,M—, Ttr,P—	Endemic species
OLEACEAE *Osmanthus sandwicensis*	Olopua	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	B,RB,L	S+,D+,Itr,M++, T+,Ptr	Endemic species
PALMAE *Pritchardia* sp.	Loulu	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	L,St	Str,D—,I—,M—, Ttr,P—	Endemic species
RUBIACEAE *Canthium odoratum*	Walahe'e, alahe'e	Kealia trail, Oahu	18 Mar 58	20 Mar 58	R	S+,D—,I—,M—, T+,P—	Indigenous, but widespread

[1] This table lists the results of alkaloid tests on other plant parts than those which were presented in Part I of this series (Swanholm *et al.*, 1959).

TABLE 3 *Continued*

BINOMIAL	LOCAL NAME	LOCALITY	DATE COLLECTED	DATE TESTED	PLANT PART(S)	ALKALOID PRECIPITATES	COMMENTS
Gouldia terminalis	Manono	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	B,L,Fl,St	S++,D+,Itr,M—, T++,P—	Endemic genus
*Morinda citrifolia**	Noni, Indian mulberry	Waiahole ditch trail, Oahu	22 Feb 57	20 Mar 57	MF	S+,D+,I—,M—, T+,P—	Aboriginal introduction
Straussia kaduana	Kopiko-kea	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	B,L,R	S+,Dtr,I—,M—, T+,P—	Endemic genus
S. Mariniana	Kopiko	Pupukea trail, Oahu	15 Jun 58	17 Jun 58	L,St	S+,Dtr,Itr,M—, T+,Ptr	Tests within this genus have been inconsistent
RUTACEAE							
Pelea clusiaefolia	Alani	Pupukea trail, Oahu	2 Mar 58	5 Mar 58	R	Str,D—,I—,M—, Ttr,P—	Endemic species
P. Wawraeana	Alani	Pupukea trail, Oahu	18 Jun 58	20 Jun 58	IF,MF	Str,D—,I—,M—, T—,P—	Endemic species
					B,R	S+,D—,I—,M—, Ttr,P—	
					ML	S++,Dtr,I—,M—, T++,Ptr	
TACCACEAE							
*Tacca Leontopetaloides**	Pia	UH campus, Oahu	1 Dec 57	19 Feb 58	Petiole	S—,D—,I—,M—, T—,P—	Aboriginal introduction, cultivated specimen
THYMELAEACEAE							
Wikstroemia oahuensis	'akia	Pupukea trail, Oahu	2 Mar 58	8 Mar 58	L,St	S+,D+,Itr,M—, T+,P—	Endemic species